BERGGREN

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REPLY TO WRITTEN OPINION
INTERNATIONAL PATENT APPLICATION PCT/FI2003/000370
APPLICANT: NOKIA CORPORATION
DUE DATE: 26 JUNE 2004

On account of the Written Opinion issued on 27.04.2004 we submit the following:

It is requested to grant a positive International Preliminary Examination Report on the basis of annexed claims 1 to 27.

Novelty Art. 33(2) PCT

The present invention has been amended to more clearly focus on the outer loop power control for the decision making.

D1 discloses inter-frequency handover (IFHO). However the way how IFHO is entered is different: D1 discloses a closed loop power control method. Furthermore D1 is identified in the application as prior art on page 3 first paragraph having disadvantages.

D2 and D3 discloses IFHO, compressed mode, measurements (during compressed mode) and synchronization as such. The present invention describes a new method to decide when to enter IFHO (and therefore compressed mode and measurements) and how to perform synchronization.

D4 and D5 describe open loop method.

D6 discloses details to compressed mode and we could not identify relevancy for the present invention.

In D7 quality refers to received pilot etc. signal quality. In the present invention quality information is received from the outer loop power control.

Hence none of the cited preference comprise all the features claimed in new independent claims. Therefore, the subject-matter of the independent claims is novel.

Inventive Step Art 33(3) & Rule 65 PCT

Document D1 discloses a closed loop power control method. Furthermore D1 discloses inter-frequency handover (IFHO). Contrary to this, D2 or D3 discloses only IFHO, compressed mode, measurements (during compressed mode) and synchronization as such.

It is concluded that D1 disclosing the IFHO and the closed loop power control method prevails with respect to the technical features and functions most similar to the invention. D1 is therefore considered as constituting the closest prior art for subject-matter of independent claims. The two-part form of the independent claims according to 6.3(b) PCT has been based on the disclosure of D1.

The technical effect of the difference has been described in the original description on page 3 lines 7 – 9. The objective problem underlying the invention is thus to provide this effect, i.e. to provide a flexible and straightforward method for controlling interfrequency handovers as disclosed on page 3 lines 10 – 11.

This problem has now been solved as claimed in the independent claims, i.e. by comparing the quality of the communication connection to a target value based on an interference control of the communication connection, wherein the target value depends on the quality target value used in downlink outer loop power control of the communication connection. This solution is not obvious for the following reasons:

D1 does not disclose any teaching to modify or incent the skilled person to modify the teaching accordingly.

Starting from D1 as closest prior art, the skilled person would thus not find the solution to the objective problem formulated above because none of the cited reference solves the problem. Thus, none of the prior art document contains a teaching prompting the skilled person to modify D1 in order to solve the problem.

We are concerned about the relevancy of D2 or D3 (and further D4 – D7) and we would like to have more reasoning from examiner why

these two references would really teach and incent the skilled person to modify D1 and achieve the present invention.

Actually it seem that the skilled person could not even do so because all the instructions are missing for "making" all the features of the present invention.

Thus starting from D1 as the closest prior art, the skilled person would not arrive at the combination of features of present independent claims.

It must be concluded that the subject-matter of independent claim 1 implies on inventive step having regard the cited prior art and thus satisfies Art. 33(3) PCT.

Generally we are concerned that the Written Opinion does not reasonably identify particular passages from the prior art documents for anticipating the present invention except for D5 or D6. Under Rule 66.2(b) PCT & Applicant Guide part I § 396: "The notification shall fully state the reasons for the opinion of the International Preliminary Examining Authority". The full reasons are clearly missing because of very cursorily identified passages in D1, D2, D3 and D4. If the examiner respectfully is still of the opinion that the present invention lack novelty or an inventive step, we would be delighted to receive fully reasoning for the matter.

Furthermore, the Written Opinion does not make a distinction between the novelty and the inventive step. European patent jurisdiction has adopted this way and we would also be delighted to see the novelty and inventive step reasoning, which are not mixed together.

We look forward to receiving an International Preliminary examination Report confirming the inventiveness of the claims and that the application as a whole conforms to the PCT. Should the Examiner fell otherwise, we request to be given an additional opportunity to submit amendments or arguments in accordance with Rule 66.4(b) PCT.

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Tomi Konkonen
Patent Attorney

Encls Marked-up pages 3,4,5 and 22 – 26
Amended specification and claims

adjacent channel interference is described, for example, in a patent publication WO 01/31958 A1. Such measurements at the own frequency do not cause interference to other communication connections employing the same frequency. Once the quality of the communication connection is determined or the adjacent channel interference is estimated, it is typically compared to a predetermined threshold value to determine, whether there is need to initiate preparatory measurements at available target frequencies. A proper threshold value for initiating preparatory measurements may vary, and it is not necessarily easy or straightforward to determine suitable threshold values.

An object of the invention is to provide a flexible and straightforward method for controlling interfrequency handovers.

Objects of the invention are achieved by comparing the quality of the communication connection to a target value based on an interference control of the communication connection. The target value ~~can, for example, depend~~s on the quality target value used in downlink outer loop power control of the communication connection.

In accordance with a first aspect of the invention, there is provided a method for controlling interfrequency handovers of a mobile station, the mobile station comprising a continuous communication mode and a combined slotted communication mode and measurement mode, the method comprising the steps of:

- changing an operation of the mobile station into the combined slotted communication mode and measurement mode for preparing an interfrequency handover, if at least a criterion specifying that a quality of a downlink signal relating to a channel on which communication takes place between the mobile station and a mobile communication system in the continuous communication mode is worse than a quality represented by a first target value, is fulfilled, wherein the first target value depends on a second target value, the second target value being related to an outer loop ~~based~~ power control ~~manner~~ of a transmission power of the downlink signal.

In accordance with a second aspect of the invention, there is provided a mobile station arranged to contain a continuous communication mode and a combined slotted communication and measurement mode, the mobile station comprising

- means for determining a value for a quality factor for a received downlink signal,
- means for controlling the communication mode of the mobile station,

- means for controlling interfrequency handovers, said means for controlling interfrequency handover being arranged to compare the determined quality factor value to a first target value for performing the interfrequency handover,
- downlink power control means arranged to compare the determined quality factor value to a second target value and to generate power control commands based on the comparison, the first target value being arranged to depend on the second target value and the second value being arranged to relate to an outer loop ~~based~~ power control ~~manner~~ of a transmission power of the downlink signal.

Preferably, the outer loop based power control manner comprises an outer loop power control for controlling the quality of the connection by setting the target value for an inner loop of a closed loop power control. ~~The loop based power control manner may also be based on the outer loop power control, a closed loop power control, or an open loop power control.~~

According to the preferred embodiments of the invention, the target value for a quality factor of the received downlink signal is used in determining a need for an interfrequency handover. The target value of the handover control method may be equal to the target value of the downlink outer loop power control, or target value of handover control may depend on the target value of the downlink outer loop power control. As target value of the downlink outer loop power control is updated, the target value of the handover control is typically updated, too.

According to another embodiment of the invention the target value of the handover control method may be equal to the maximum downlink transmission power allocated for the user, or the target value of the handover control may depend on the (maximum) downlink transmission power allocated for the user.

According to yet another embodiment of the invention the target value of the handover control method may be equal to a target value for the maximum uplink transmission power allocated for the user that is based on open loop power control, or the target value of the handover control may depend on the (maximum) uplink transmission power allocated for the user that is based on open loop power control. The uplink power of the mobile station is set to depend on the received pilot power or quality. If the quality is not adequate, the power should be increased. This may imply need for the IFHO because the quality is not adequate, for example because of adjacent channel interference.

According to yet another embodiment for the outer loop power control, the second target value represents BLER (Block Error Rate)/FER (Frame Error Rate)/BER (Bit Error Rate) target value for the outer loop power control. The first target value comprises a function of the second target value, and the quality refers to the BLER/FER/BER measurement.

According to yet another embodiment for the outer loop power control, the second target value represents SIR (Signal to Interference Ratio) target which is obtained from the outer loop power control. The first target value comprises a function of the second target value, and the quality refers to the SIR measurement.

~~According to yet another embodiment for the closed loop power control, the second target value represents maximum allowed power in the traffic channel of the mobile communication. The first target value comprises a function of the second target value, and the quality is applied as a user power which is defined by the closed loop power control.~~

~~According to yet another embodiment for the open loop power control, the second target value comprises a pilot (CPICH) SIR (Signal to Interference Ratio) target which is defined to the system. The first target value comprises a function of the second target value, and the quality refers to the CPICH SIR measurement.~~

~~According to yet another embodiment for the open loop power control, the second target value represents maximum allowed power in the uplink. The first target value comprises a function of the second target value, and the quality refers to the uplink maximum allowed power which is based on the open loop power control definition.~~

Power control is a very important feature in CDMA systems. Therefore, suitable target values for quality factors used in power control are determined carefully. Advantage of this effort may be taken by using the same target values, or values that depend on the downlink ~~open, closed or~~ outer loop power control target values, for example, via a known function, in controlling interfrequency handovers. There typically is strong adjacent channel interference near a radio transmitter employing an adjacent frequency, and the target value of the quality factor may not be reached near such a transmitter. A method according to the preferred embodiments of the invention detects this situation and preparations for an interfrequency handover are typically initiated.

Simulation results show that a method according to the preferred embodiments of the invention provides efficiency. In a situation, where an area is covered by two

Claims

1. A method for controlling interfrequency handovers of a mobile station, the mobile station comprising a continuous communication mode and a combined slotted communication mode and measurement mode, the method comprising the steps of:

- changing the operation of the mobile station into the combined slotted communication mode and measurement mode for preparing an interfrequency handover, if at least a criterion specifying that a quality of a downlink signal relating to a channel on which communication takes place between the mobile station and a mobile communication system in the continuous communication mode is worse than a quality represented by a first target value, is fulfilled,

characterized in that the first target value depends on a second target value, the second target value being related to an outer loop ~~based~~ power control ~~manner~~ of a transmission power of the downlink signal.

2. A method according to claim 1, further comprising the step of:

- updating the first target value at first time instants of those time instants at which the second target value is updated by the power control manner of the transmission power.

3. A method according to claim 2, wherein the first target value is updated for every radio frame.

4. A method according to claim 2, wherein the first target value is updated for every interleaving period.

5. A method according to any one of the preceding claims, wherein the first target value is equal to the second target value.

6. A method according to any one of the claims 1 to 4, wherein the first target value corresponds to a worse quality than the second target value.

7. A method according to any one of the preceding claims, wherein the value for the quality represented by a first target value is determined for every time slot.

8. A method according to any one of the preceding claims, wherein a further criterion specifies that the criterion is to be fulfilled for a certain first predetermined time period.

9. A method according to any one of the preceding claims, further comprising the step of:
- estimating adjacent channel interference on the channel on which communication takes place in the continuous communication mode.

10. A method according to claim 9, wherein said adjacent channel interference is estimated, if the determined value for the quality represented by a first target value is below a predetermined value.

11. A method according to claim 9 or 10, further comprising the step of:
- measuring interference on an adjacent channel in the combined slotted communication and measurement mode.

12. A method according to any one of the preceding claims, further comprising the steps of:
- performing an interfrequency handover to a second channel, and
- after entering a continuous mode in the second channel, inhibiting a further interfrequency handover for a certain second predetermined time period.

13. A method according to any one of the preceding claims, further comprising the step of:
- performing preparatory measurements for an interfrequency handover in the combined slotted communication mode and measurement mode.

14. A method according to claim 13, **characterized** in that it further comprises the step of:
- in the combined slotted communication mode and measurement mode, synchronizing the mobile station with at least one base station before selection of a target frequency and/or the target base station(s) for the interfrequency handover.

15. A method according to claim 14, further comprising the step of:
- sending a request (1107, 1108) for the interfrequency handover to the cellular radio system from the mobile station,
and wherein the step of synchronization is performed after sending the request.

16. A method according to claim 14, further comprising the step of:
- triggering, based on said preparatory measurements, the synchronization of the mobile station with the at least one base station.

17. A method according to any one of the claims 14 to 16, wherein the mobile station is synchronized in at least one available target frequency with each base station relating to which said preparatory measurements are made.

18. A method according to any one of the claims 14 to 16, wherein the mobile station is synchronized in at least one available target frequency with at least two base stations.

19. A method according to claim 18, wherein said at least two base stations belong to the active set of the mobile station.

20. A method according to claim 19, wherein the synchronization is performed with all base stations belonging to the active set of the mobile station.

21. A method according to claim 19, further comprising the step of:
- performing the interfrequency handover to all base stations belonging to the active set of the mobile station

22. A method according to claim 18 or 19, **characterized** in that it further comprises the step of:
- performing the interfrequency handover to said at least two base stations.

~~23. A method according to claim 1, wherein the loop based power control manner comprises at least one of an outer loop power control, a closed loop power control, and an open loop power control.~~

234. A method according to claim 1, wherein the loop based power control manner ~~comprises~~is adapted to ~~an outer loop power control for~~ control~~ling~~ the quality of the connection by setting the target value for an inner loop of a closed loop power control.

245. A method for controlling an interfrequency handover of a mobile station, the mobile station comprising a continuous communication mode, the method comprising the steps of:
- determining a value for a quality factor for a received downlink signal,

characterized in that, said interfrequency handover comprises a blind interfrequency handover and the method further comprises the steps of:
- comparing the determined quality factor value to a first target value for performing the blind interfrequency handover,
- comparing the determined quality factor value to a second target value, and

- generating power control commands based on the comparison, the first target value being arranged to depend on the second target value and the second value being arranged to relate to an outer loop ~~based~~ power control ~~manner~~ of a transmission power of the downlink signal.

256. A mobile station arranged to contain a continuous communication mode and a combined slotted communication and measurement mode, the mobile station comprising

- means (1207,1212) for determining a value for a quality factor for a received downlink signal,
- means (1207,1215) for controlling the communication mode of the mobile station,

characterized in that the mobile station further comprises

- means (1207,1210) for controlling interfrequency handovers, said means for controlling interfrequency handover being arranged to compare the determined quality factor value to a first target value for performing the interfrequency handover,
- downlink power control means (1207,1211) arranged to compare the determined quality factor value to a second target value and to generate power control commands based on the comparison, the first target value being arranged to depend on the second target value and the second value being arranged to relate to an outer loop ~~based~~ power control ~~manner~~ of a transmission power of the downlink signal.

267. A mobile station according to claim 256, **characterized** in that it further comprises

- means (1207,1214) for synchronizing the mobile station with a base station, said means arranged to perform the synchronization during the combined slotted communication and measurement mode before selection of a target frequency and/or a target base station(s) for an inferfrequency handover.

278. A mobile station arranged to contain a continuous communication mode, the mobile station comprising

- means (1207,1212) for determining a value for a quality factor for a received downlink signal,

characterized in that the mobile station further comprises

- means (1207,1210) for controlling blind interfrequency handovers, said means for controlling blind interfrequency handover being arranged to compare the determined quality factor value to a first target value for performing the blind interfrequency handover,

- downlink power control means (1207,1211) arranged to compare the determined quality factor value to a second target value and to generate power control commands based on the comparison, the first target value being arranged to depend on the second target value and the second value being arranged to relate to an outer loop ~~based~~ power control ~~manner~~ of a transmission power of the downlink signal.